Foreword

In many ways, bats are the nocturnal equivalent of birds (Kunz, 1982). Like birds, they consume large numbers of insects that cause harm to agriculture and to humans; researchers estimate that the value of bat control of cotton crop pests in eight counties in south-central Texas ranges from $121,000 to $1,725,000 per year (Cleveland and others, 2006). Bats also play an important role as pollinators and in spreading plant seeds by eating the fruits of some plants. The estimated 1,100 species of bats worldwide comprise about 20 percent of all mammal species (Tudge, 2000), are second only to rodents in number of species, and are likely the most numerous in total individuals of any type of mammal (Kunz 1982). Despite their important ecological roles and benefits to humans, bats are among the most maligned and mysterious animal group in existence, largely due to folklore and unfamiliarity with the true nature of these primarily nonhematophagous, or nonblood feeding, species (King, 1993).

The notoriety associated with rabies in vampire bats of the tropical and subtropical regions of the New World is unfortunately transposed by many to also reflect the demeanor and consequences of the presence of other types of bats. Clearly, vampire bat rabies was a prominent challenge for early Spanish colonists and their domestic animals during their settlement within Latin America (Baer, 1975a; Lopez and others, 1992). Because of vampire bat rabies, the presence of bats in urban environments of the Northern Hemisphere commonly elicits fear among many adults, but wonderment among the young and the young-at-heart. The former tend to associate the presence of bats with rabies, while the latter see only the uniqueness of these highly specialized flying mammals and often place themselves at risk by attempting to capture and handle these animals for closer examination.

Rabies in a nonhematophagous North American bat was not documented until 1953, when a yellow bat (*Dasypterus floridanus*, now *Lasiurus intermedius*, the Northern yellow bat) was examined following its aggressive biting of a 7-year-old boy in Florida. Fortunately, despite no previous documentation of rabies in insectivorous bats in the United States, the child received prompt postexposure prophylactic treatment for rabies and did not become clinically ill (Venters and others, 1954, Scatterday, 1954). Subsequent investigations resulted in retrospective diagnoses of bat rabies in the USA in 1951 and, possibly, even 30 years earlier, suggesting the presence of rabies in **insectivorous** bats long before its recognition (Baer, 1975b). During recent decades, an average of 700 to 800 cases of rabid insectivorous bats has been diagnosed annually in the USA (Rupprecht and others, 1995). During 2006, 1,692 cases of rabies were reported in bats, a 14.5 percent increase over 2005 and 24.4 percent of the total animal rabies cases. Only raccoons accounted for a greater number of rabies cases in the USA during 2006 (Blanton and others, 2007).

Although the annual number of human rabies deaths in the USA remains very small, most of those deaths are attributed to unrecognized exposures to rabies associated with bats, primarily the silver-haired bat and the tricolored bat, two infrequently encountered bat species. The ecological relationships driving such outcomes extend beyond evolutionary increases in viral infectivity reported for these bat species (Messenger and others, 2003). Equally, if not more important, are factors that result in human contact with these species. Human-induced landscape changes influence the distribution and abundance of animal populations, and these types of changes have had a major role in the ascension of wildlife rabies

(Rupprecht and others, 1995) and likely will continue to do so. Bat-associated human disease emergence during recent years includes Nipah, Marburg, "Melaka," and Hendra viruses, and human Nipah virus infections clearly result from landscape changes that cause the bats to relocate their roosts to sites where interspecies disease transmission is facilitated (Daniels and others, 2007). That outcome emphasizes the importance of understanding bat ecology as a component of disease ecology.

Knowledge of bat ecology is especially important when humans and bats share environments. This information is needed to properly educate people about bats and for the application of preemptive actions, including education, for minimizing disease risks that may be present. Simple, inexpensive means for bat exclusion noted in the text can be installed to permit bats to depart from but prevent re-entry into buildings. This text also stresses the importance of house cats in the transmission of bat rabies, a situation that can largely be controlled by preemptive actions identified by the author and that many readers may apply to their daily lives with their pet cats.

Of special importance is the potential for contact between children and bats. Young people are often at higher risk for exposure to rabid bats because their uninhibited curiosity may result in their handling of moribund and injured bats, including those that may have been captured by the family cat. This writer had several personal experiences evaluating bats that were picked up by students, brought to grade school biology classes, and that proved to be rabid. Fortunately, no human rabies cases resulted from those events.

Education about bats provides valuable balance so that disease risks are not overstated, fostering fear of these species, or understated to the extent that people are placed at undue risk. Personal experiences have indicated that private sector presentations by those interested in bat conservation often understate disease considerations and demonstrate risky behaviors, such as handling bats without protective gloves, in efforts to overcome negative perspectives of bats advanced by others. These same types of indiscretions also appear in various publications (King, 1993).

The best defense against potential disease risks posed by bats, or any animal species, is a sound understanding of disease ecology and the wise application of that knowledge. Through this publication, Dr. Constantine strives to provide the reader with these attributes by sharing over a half-century of personal experiences and scientific investigations of bat rabies ecology. During his career, Dr. Constantine has significantly contributed to the scientific knowledge of this complex disease and challenged existing dogma in ways that have enhanced our current understanding of rabies transmission (see literature citations associated with the text). This unique and highly informative presentation incorporates anecdotes as well as hard science to provide both nonscientists and specialists with numerous points to ponder and a better understanding of bats as part of our biological world. The presentation is enhanced by the many illustrations that portray diversity among bat species, some of their adaptive features, and other aspects of bat biology. Bats have successfully colonized most regions of earth except for Antarctica and some other treeless northern areas of extreme cold (Kunz, 1982). These species need to be conserved for their ecological importance and for the benefits that they provide humans, rather than feared because of disease.

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